

Nuclear Level densities

USES:

Hauser - Feshbach

- wide range of nuclei
& energies

Nuclear fission

- actinides
- deformed states
 - rotational states

$$\rho = \frac{\sqrt{\pi}}{12} \frac{e^{2\sqrt{a} E_x}}{E^{5/4} a^{1/4}}$$

$$a = \frac{\hbar^2}{6} g(E_F)$$

$$E_x = E - E_0 = \epsilon + \overbrace{\epsilon_{\text{pair}} + \epsilon_{\text{st}}}^{-\delta}$$

assumptions

Saddle point approximation
 $E > E_{\text{min}}$

temperature dependent
 Hartree-Fock

Stratinsky Energy Theorem

$$\epsilon_{\text{sp}} = \sqrt{\frac{\epsilon - \delta}{a}} > \frac{\hbar\omega}{2} > 21 A^{-1/3}$$

$g(\epsilon) = \text{constant}$

$$g(\epsilon) = g(E_F) + (\epsilon - E_F) g'(E_F)$$

Problems:

- Can conditions on τ (or ϵ)
be satisfied simultaneously
- Note Tom Massey's
extrapolation

Collective effects

- rotational states
 - fission (for example)
- other collective
enhancements
- energy dependent
effective mass

single Particle levels

- counting can give level density
- saddle point

Used in fission calculations

- chip Britt

"Real" calculations

- shell model

- Random matrices

GOE does not agree
with shell model.

- only way to actually
calculate level densities
from first principles?

- calculations of level densities
not available in the
short term.